

# InTech®

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# 50

## From Controls to Automation

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It's all about Automation and Control at ISA EXPO 2003 in Houston 21-23 October. For more information about ISA EXPO 2003, see the show program supplement or go to [www.isa.org/isaexpo2003](http://www.isa.org/isaexpo2003).





ble logic controller (PLC). First demonstrated at GM in 1969 as Bedford Associates Modicon 084 solid-state sequential logic solver, Morley designed it for factory automation and continuous processing applications. The quintessential engineer and inventor holds more than 20 U.S. and foreign patents and continues to work on novel computer designs, artificial intelligence, chaos and complexity, and the factory of the future.



**Odo Struger** Often called the father of Allen-Bradley's PLC and credited with creating that acronym, Dr. Struger also developed PLC application software during his nearly forty-year career at Allen-Bradley/Rockwell and played a leadership role in developing National Electrical Manufacturers Association (NEMA) and International Electrotechnical Commission (IEC) 1131-3 PLC programming language standards. After moving from Austria to the U.S. in the 1950s, he became an engineer at Allen-Bradley in 1958, retiring in 1997 as Rockwell Automation's vice president of technology.

**Hans Baumann** One of the world's eminent experts on flow control technologies and control valve designs, including noise prediction methods in control valves, Baumann founded the H.D. Baumann Co. in Portsmouth, N.H. (now an Emerson/Fisher subsidiary). A director of the ISA standards and practices department, he continues to serve as the U.S. technical expert on the IEC standard committee SC65B/WG9 for control valves. He is a leader in revisions to the sizing standards for very low Cv valves. His efforts and technical expertise were instrumental in getting the IEC community to accept the technically based ISA noise prediction approach, a standard that continues to gain worldwide acceptance for predicting noise associated with valves.

**Edgar H. Bristol** Named for his grandfather—the founder of Foxboro Company—Edgar was the originator of relative gain analysis and of the EXACT self-tuning controller. He and Pete Hansen, a noted Foxboro electrical and mechanical engineer, broke ground in their work in multivariable and adaptive control, software, and self-tuning controllers.

**Lotfi A. Zadeh** Considered the father of fuzzy logic control, Dr. Zadeh, head of the electrical engineering department at the University of California at Berkeley, first used the term "fuzzy" in the engineering journal *Proceedings of the IRE* in 1962. Fuzzy logic shortens the time for engineering development and is used in system control and analysis design.

**Walter Bajek** During a fifty-year career at United Oil Products (UOP), Bajek distinguished himself in the design and application of process control instrumentation. He participated in the design of more than 230 process

units and worked at 50 field assignments, holds 44 patents, and has authored numerous technical articles. An ISA fellow, he became an honorary member in 1993. He received ISA's highest award, the Albert Sperry Gold Medal, in 1981.

**Dennis Wisnosky** Founder and chief executive officer of Wizdom Systems, Wisnosky has published over 100 papers in the fields of management, computer-aided design/computer-aided manufacturing, electronics, computer science, and computer-integrated manufacturing (CIM). He is the originator of the funnel visualization of enterprise control networks. In May of 1997, *Fortune* magazine recognized Wisnosky as "one of the five heroes of manufacturing."

**Bud Keyes** A legend in the business, Keyes guided Bailey Controls during its most successful period. Keyes led the development of Network 90, and he holds many patents. Since that time, he made major contributions to Emerson, helping develop DeltaV. Keyes is in the Process Control Hall of Fame.

**Ed Hurd** A longtime Honeywell veteran, Hurd was a major driver of the Honeywell 2000 and its successors, and led Honeywell's industrial control organization during its fastest growth period. Hurd served as president of Industrial Control from 1993 to 1995 and, before that, was vice president and general manager of Honeywell's Industrial Automation and Control Group. Hired in 1952, he won a Sweat Award in 1967 for circuitry design and that same year was the design architect for an assignment called Project 72. Working for about two years, the group synthesized a next-generation control system. The project eventually led to the TDC 2000, a distributed control system that took the industrial automation and control group from \$5 million to \$500 million in five years.

**Peter G. Martin** Recently selected by *Fortune* magazine as a "hero of U.S. manufacturing," Martin is vice president of marketing at the Invensys Production Management division, Foxboro, Mass. Martin's patented dynamic performance measures approach, Dynamic Performance Measures (DPMs), provides process control operators in industrial manufacturing plants (refineries, chemical plants, power plants, food and beverage plants, etc.) with immediate feedback on how their actions impact plant profitability.

#### TECHNOLOGISTS AND MORE

**Tom Fisher** Chairman of the World Batch Forum and a leading figure in the development of batch processing standards before his death in 2001, Fisher is the father of batch automation. He was a founder of ISA's SP88 committee, which formulated the batch manufacturing standards in use throughout the world, serving as chairman of the committee and editor of the standards as well. After joining Lubrizol in 1967 as a process engineer, he rose to become the company's operations

technology manager. He authored several books and articles on batch control.

**Lynn Craig** One of the world's foremost authorities on batch processing technologies widely used by food, pharmaceutical, and specialty chemical companies, Craig is the president of Manufacturing



Automation Associates, Inc., a consulting firm specializing in manufacturing methods and technologies for the batch processing industries. He is chairman of ISA's SP88 batch control committee, past chairman of the World Batch Forum, and also serves as convener of an international standards group addressing the same subject.

**Dick Caro** and **Tom Phinney** As chairman of ISA SP50 and IEC fieldbus standards committees, Caro played a major role driving fieldbus standards and the evolution to industrial Ethernet. Caro, a widely recognized networking consultant, has worked with ARC Advisory Group, Arthur D. Little, ModComp, and the Foxboro Company. In 1983, he created the first Ethernet-based process control system for Autech Data Systems. A twenty-eight-year Honeywell veteran, Phinney is currently convener of the two active IEC fieldbus standards working groups and is editor for the IEC 61158-3 data link layers standards and the corresponding ISA SP50 committee standard.

**John Berra** The president of Emerson Process Management and Emerson executive vice president received ISA's "Life Achievement Award" at ISA 2002 in recognition of long-term dedication and contributions to the instrumentation, systems, and automation community. As of 2001, only seven people had received the honor, which was first given in 1981. Berra, who began his career as an end user at Monsanto Co., played a major role in the development of three major manufacturing communications protocols—HART, Foundation Fieldbus, and OPC.

**Richard Rimbach** Considered by many to be the father of ISA, Rimbach served as ISA's first executive director. In January 1928, he published the first issue of *Instruments* magazine, which, in effect, gave birth to instrumentation and control as a distinct discipline.

**Glenn F. Harvey** ISA executive director for thirty-two years, Harvey oversaw ISA's direction and saw the focus shift from valves and other electrical, mechanical, and pneumatic to microprocessors and PCs to a solutions-based, software-driven discipline. Under his leadership, ISA grew from a few thousand to a peak of more than 60,000 members during the 1990s.



## ENTREPRENEURS

### C. William Siemens and E. Werner Siemens

The German inventor brothers set up shop in London in 1844. In 1866, Werner Siemens invented the first dynamo.

**Edward Brown** founded Brown Instrument Co. in the mid-1800s, just before the Civil War. Many considered it to be the first known U.S. maker of process instruments. Edward Brown invented and produced the first pyrometer to measure temperature; it was the first commercial industrial instrument. (Honeywell acquired Brown in 1934.)

**George Taylor** In 1851, at the young age of 19, Taylor and **David Kendall** pooled their resources to form what eventually became Taylor Instrument Co. Their first products were a few tin-case and wood-case thermometers and mercury barometers. In 1866, George's brother Frank joined the business. The Taylor brothers soon recognized the need for thermometers for industrial processes, and began research and development about 1887.

**Mark C. Honeywell** The founder of Honeywell Heating Specialty Co. in 1906 built a hot-water system for homes. Giant Honeywell actually traces its roots, however, to 1885, when Albert M. Butz filed his first temperature-control patent. He formed the Butz Thermo-Electric Regulator Co., which reorganized around entrepreneur William R. Sweatt in 1893. That company merged with Sweatt's Minneapolis Heat Regulator Co. in 1913. Honeywell then acquired that company.

**Benjamin Bristol** and his two sons, **Bennet and Edgar H. Bristol** The father and sons cofounded Industrial Instrumentation Co. in 1908. It was renamed The Foxboro Company in 1914. Prolific inventors, they have dozens of instrumentation patents to their credit. Bennet and Edgar each had a son, Ben Bristol and Rex Bristol, who led Foxboro's next generation of Bristol leadership.

**William Fisher** Today's Fisher-Rosemount Systems got its start in 1880, when Fisher invented the Type 1 constant pressure pump governor, designed to maintain pressure in Marshalltown, Iowa's water mains when fighting fires. Fisher later founded and incorporated the Fisher Governor Company in 1888 in that Iowa town.

**Morris E. Leeds** and **Edwin F. Northrup** When starting his company in 1899, Leeds had only 25 employees and a "plant" that was a cramped second floor over a mid-center-city Philadelphia jewelry store. It originally manufactured precision instruments for laboratory applications, such as galvanometers and resistance boxes, and expanded in the 1920s to include industrial instrumentation. In 1911, the company developed a mechanically sensing potentiometric recorder.

**Lynde Bradley** Aided by a \$1,000 loan from Dr. Stanton Allen, one of Milwaukee's leading orthopedic surgeons, Bradley founded Compression Rheostat Co., forerunner of Allen-Bradley Co., in 1903.

**Ervin G. Bailey** Inventor of the Bailey Boiler Meter 1915, Bailey founded Bailey Meter Co., forerunner of Bailey Controls, in 1916. A breakthrough, the meter helped boiler operators achieve and maintain maximum process efficiency. The device combined air flow and steam flow measurements on the same chart to let operators know how much steam the boiler was emitting, how much air was being used, and the condition of the fuel bed.

**A. O. Beckman** ISA's seventh president, the Beckman Instruments founder was motivated by a 1930s discovery that biochemical materials, particularly vitamin A, absorb in the ultraviolet (UV) region, giving a molecular "fingerprint" that allows easy identification in complex mixtures.



Beckman was quick to see UV-vis spectrophotometer of his own design. He developed the first prototype UV-vis spectrophotometer, dubbed the Model A, in 1940. Success came to the fore with the Model D, unveiled in 1941 and built with an experimental RCA phototube.

**Kermit Fischer** and his only employee, **George Porter** In March 1937, a sign reading "Fischer & Porter Co." went up for the first time, in Philadelphia's old Germantown section. Its initial products were "rotameters," or variable-area flow rate meters. By 1940, a total of five houses and backyard shops around the neighborhood bore Fischer & Porter signs.

**Coleman B. Moore** One year after founding Moore Products in 1940, the company sold its first standard product, a valve positioner. In 1946, Moore developed the Nullmatic "stack" controller, a sophisticated force-balance instrument. Measuring only five inches on a side, it eschewed the circular pen-and-chart recorder and allowed construction of dense control panels. By 1948, the company employed 80 people.

**Robert E. Keppel, Vernon Heath**, ISA senior fellow, and **Frank Werner** These three founded Rosemount Engineering Co. in 1956 in the small farming community of Rosemount, Minn. Initially focused on aerospace products, Rosemount diversified into process control instrumentation. It developed the world's best-selling temperature transmitter, the Model 444, in 1969 and unveiled the Model 1151, which became the standard in pressure transmitters. It merged with Emerson Electric Co. in 1976.

**James Truchard** Chief executive officer and co-founder of National Instruments along with Jeff Kodosky and William Nowlin, Truchard pioneered development of virtual instrumentation software and hardware to revolutionize the way engineers and scientists approach measurement



and automation applications. In 1986, Truchard and Kodosky invented the award-winning LabVIEW graphical development software, which introduced the concept of virtual instrumentation. In 2002 ISA named him an honorary member.

**Fred L. Maltby** Founder of Drexelbrook Engineering, Maltby developed the RF/admittance level transmitter. He holds 51 U.S. and a number of international patents in electrical measurement and is an authority in industrial level measurement. An ISA fellow, he received ISA's Life Achievement Award in 2002.

**Bill Gates** With Windows, the Microsoft founder developed practical graphical user interface software and taught the world how to use it. Microsoft's awesome marketing muscle created the "open systems" movement (open systems around Windows), which ultimately prevailed over dedicated systems that previously dominated process control industries.

**Dennis Morin** and **Steven Rubin** Principal founder of human-machine interface/supervisory control and data acquisition company Wonderware, Morin "bet the company" on Microsoft's Windows software and started a major transition from dedicated, hardware-based process control to Windows-based "open" technology. Ruben, meanwhile, founded rival Intellution after extensive experience at Foxboro and EMC Controls designing large, centralized, distributed processing systems. ISA named Rubin a fellow in 1997 "for providing technical leadership developing and introducing the first DOS-based process control system for personal computers."

**Betty Ruth Hollander** Chairwoman and chief executive officer of Omega Technologies, Hollander built a marketing

and distribution powerhouse, breaking new industry ground by marketing and distributing measurement and control instrumentation through online and catalog-type sales channels. Her innovative sales strategy grew Omega from a one-product company when formed in 1962 to a full-service engineering firm that today offers more than 100,000 measurement and control products distributed as commodities. Hollander has five patents in temperature measurement products and methodology. ISA named her an honorary member in 2000.



## TECHNOLOGISTS AND ACADEMIA

**Francis Greg Shinsky** Many consider the now retired "controls guru" at Foxboro Company the father of feedforward control. He pioneered the application of good process control in general to improve plant performance in a tangible manner. Holder of 17 U.S. patents, Shinsky made significant con-

tributions to the advancement of pH control and distillation column control and is perhaps the most well known and influential teacher in the process control field.

**Theodore (Ted) J. Williams** The now retired Purdue University professor and 1968 ISA president pioneered both analog control applications and digital systems. He played a pivotal role implementing the very first direct digital control computer at Monsanto Co., Luling, La., in 1960—after Monsanto and Ramo-Wooldridge Co. began a cooperative project using digital computers. Out of his Purdue Workshop on Industrial Control Systems came many concepts now used for fieldbus, OPC, batch control, and ISA 95.01 on levels of automation.

**Gregory McMillan** Known for advancing control instrumentation applications in the chemical industry, the former Monsanto Co. engineer's numerous articles and books have helped many starting engineers in the area of control and measurement.



**Béla Lipták** Known for spreading knowledge in the instrumentation and control domain, his handbooks have become a standard in control engineering and a noteworthy contribution to the industry.

**Otto J.M. Smith** A professor at the

University of California-Berkeley, he developed the Smith Predictor in about 1957. His model-based control strategy enables a controller to predict the future effect of its present efforts and react immediately to those predictions.

#### ACADEMIA

**Karl Johan Åström** Vice dean, dean of the department of engineering physics, and chairman of the computing board at Lund University, he also has held visiting appointments at many universities in the U.S., Europe, and Asia. He is an editor of *Automatica* and other journals. Åström's comprehensive analysis of PID implementation and behavior set the foundation for a better understanding of PID in feedback control. With F. Hector of Philips, he developed a new principle for Schuler tuning of an inertial platform, which they successfully flight tested. After working on optimal and stochastic control as a visiting scientist at IBM Research Laboratories, he was responsible for modeling and implementing computer control systems for paper machines in Sweden.

**R. Russell Rhinehart** The Edward E. Bartlett chairman and head of process control at Oklahoma State University, Rhinehart previously worked thirteen years in the chemical industry and twelve years as a professor at Texas Tech University. Russ's research interest is "process control." Focused on the "automaton of process management," his team is developing methods for nonlinear

control, process optimization, computer perception, learning systems, autonomous control, and statistically based triggers. They complement theoretical analysis with experimental demonstration.



**Cecil L. Smith** Papers written by the Louisiana State University (LSU) researcher, later a private consultant, have benefited control engineers by providing a better understanding of how process dynamics impact control mode selection. Smith worked with Paul W. Murrill, another LSU researcher, on early research in digital system tuning methods. At LSU, he played a major part in creating a pre-eminent program in process control in the department of chemical engineering.

**Paul Murrill** A faculty member and past department chair at LSU's department of chemical engineering, Murrill could make difficult concepts easy to understand. He wrote one of the first textbooks on Automatic Process Control in 1967, and later cowrote nine other books on subjects including process mathematical modeling and computer programming. After retiring from LSU, Murrill headed research and development for Ethyl Corp., and then became chairman and chief executive officer of Gulf States Utilities (now Entergy). IT

## Top technologies and events

Technology and change. Those are two words that seem to work very well together and fit within the boundaries of automation and control.

So, in this 50th anniversary year, *InTech's* editors, along with the 80 or so instrumentation and control experts throughout the industry, named the top technical developments or events that influenced the world of measurement and control.

#### ■ WORLD WAR II

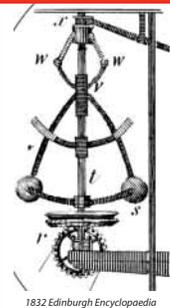
U.S. process industries, particularly the chemical industry, played a major role in winning World War II. Competing chemical and equipment suppliers joined forces to respond to the national emergency. Four projects, in particular, were of unprecedented scope, including The Manhattan Project (1942), which produced the atomic bomb, high-octane aviation gasoline, synthetic rubber, and manufacturing penicillin. Demand for aviation fuel soared. Refineries expanded. In 1940 the average production was 30,000 barrels per day. By war's end, in 1945, it was 580,000 barrels per day.

#### ■ ZIEGLER-NICHOLS' METHOD

In the late 1930s, Taylor Instruments researchers, for the first time, integrated previously separate proportional, integral, and derivative (PID) (then known as "pre-act") control into the Taylor Model 56R Fulscope con-

troller. However, tuning was a problem. To solve it, Taylor engineers John Ziegler and Nathaniel Nichols developed the well-known "Ziegler-Nichols" method of tuning, still in use today. The procedure involves increasing the proportional response until one obtains a sustained oscillation (also referred to as "ultimate sensitivity"), setting the proportional adjustment to half the value that caused the ultimate sensitivity, setting the integral rate equal to the ultimate frequency, and setting the derivative or pre-act to one-eighth this frequency.

**Flyball governor**  
James Watt, 1774



1832 Edinburgh Encyclopaedia

#### ■ PNEUMATIC INSTRUMENTATION

In 1928, Foxboro's first pneumatic operational amplifier laid the groundwork for an entire generation of pneumatic instrumentation, much of it still recording industrial processes in plants around the world. A year later, Foxboro followed with the first proportional-plus-reset (integral) controller.

#### ■ ALL-ELECTRONIC INSTRUMENTS

Honeywell in 1938 introduced the first electronic potentiometer, Class 15, which implemented servo drive indicators and recording pens. In June 1944, Foxboro introduced

**Crane controller**  
Allen-Bradley, 1907



the first all-electronic instrument line, the Dynalog temperature and pH recorders and controllers. What's believed to be the first electronic controller, the Autronic, developed by Swartwout Co. of Cleveland, hit the market in 1951.

#### ■ CHART RECORDERS

Brown Instruments (later Honeywell) in 1941 introduced the Model 15 chart recorder. The instrument saw heavy use during WWII in the Manhattan Project and, after the war, by the chemical, petroleum, nuclear reactor, and power industries.

#### ■ TRANSISTORS, INTEGRATED CIRCUITS

Everything in industrial and everyday life changed after John Bardeen, Walter Brattain, and William Shockley of Bell Laboratories invented the transistor in 1947. Products in the 1950s began moving from vacuum tubes to transistors, dramatically reducing power consumption, size, and costs, and significantly improving reliability. In the early 1970s, Intel's 4004 launched the "computer on a chip," single-chip microprocessor revolution.

#### ■ BIRTH OF ISA

Representatives from regional technical societies gathered in New York on 2 December 1944. At a second meeting on 17

February 1945 in Chicago, they adopted the name Instrument Society of America. ISA was officially founded at the third organization meeting on 28 April 1945, held in Pittsburgh, with 15 local instrument societies and about 1,000 members. The first issue of the *ISA Journal*, predecessor to *InTech*, was published 50 years ago, in January 1954.



### ■ PNEUMATIC DIFFERENTIAL PRESSURE TRANSMITTER

Introduced by Foxboro in 1948, in conjunction with appropriate "primary devices" (orifice plates, venturi tubes, etc.), Foxboro's "dP Cell" differential pressure (dP) transmitter provided the first relatively "bulletproof" method of measuring flow and level in process control applications. The dP Cell provided a means to accurately and reliably measure low-range differential pressures at pipeline static pressures, which could typically be hundreds of pounds per square inch, while providing protection against accidental overranges.

### ■ FEEDFORWARD CONTROL

Engineers applied feedforward control to heat transfer and distillation in the 1960s, helped by the development of pneumatic and electronic analog multipliers.

### ■ BIRTH OF DISTRIBUTED CONTROL SYSTEMS

About the same time in the mid-1970s, Honeywell in the U.S. and Yokogawa in Japan introduced the first distributed control systems (DCS)—marking a significant and far-reaching change in the way one could configure and apply control systems. A four-person Honeywell group spent nearly two years synthesizing what a next-generation control system would look like. The project eventually led to the TDC 2000, a DCS that

**Pneumatic control panel**  
Foxboro, 1950



took Honeywell's industrial automation and control business from \$5 million to \$500 million in five years. The concept behind the Yokogawa Centum and Honeywell TDC 2000 was that supervisory minicomputers can control several microprocessor-based loop controllers with a push button and cathode ray tube (CRT)-based display for the operator rather than an annunciator panel.

### ■ FIRST PROGRAMMABLE LOGIC CONTROLLERS

Shipment of the first programmable logic controllers (PLCs), including the Modicon 084 designed in 1969 by Dick Morley, was a major milestone in the automation industry. Morley was first with graphical ladder logic as a programming language. Odo Struger is the father of Allen-Bradley's PLC and is credited with creating the PLC acronym. Other PLC inventors include Ray Golden of Information Instruments Inc. (III).

### ■ ROSEMOUNT DIFFERENTIAL PRESSURE TRANSMITTER

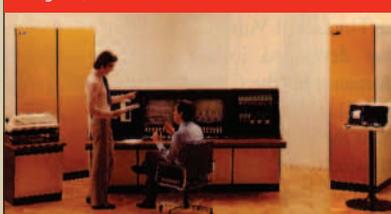
Rosemount's all solid-state differential pressure transmitter, introduced in 1969, changed the course of electronic trans-

mitters. It still enjoys market leadership.

### ■ CONVERSION TO DIGITAL TECHNOLOGY

The first computer system applied to process control may be the DIGITAC machine developed in 1954 by Hughes Aircraft Co., which generated the first major patent in that field. In 1956, the first report appeared on results achieved by Donald P. Eckmann and his associates at the Case Institute of Technology regarding work on computer control of a batch hydrogenation process. In the late 1960s, Ted Williams of Monsanto Co. pioneered the use of computers in process control. Microprocessors hit process control in the early 1970s. "Affordable computer capability finally gave automation its name and provided real tools for practitioners in the field. Compared to that, everything else pales to a dull gray," said Lynn Craig.

**Distributed control system (DCS)**  
Yokogawa, 1975



### ■ HMI/SCADA

USDATA in 1978 introduced REACT, the industry's first user-configurable colorgraphic workstation (hardware and software), providing a human-machine interface (HMI) for programmable controllers. It followed in 1986 with PC-based FactoryLink, providing HMI and supervisory control and data acquisition (SCADA) functions. Genesis, by Iconics, also came in the 1980s. Microsoft Windows won the HMI/SCADA wars, however, led by Wonderware's InTouch.

### ■ OPEN SYSTEMS

IBM's PC, unveiled in August 1981, marked the beginning of the end for proprietary process control computers. That's because it also marked the beginning of Microsoft's arrival as a big time software and plant-floor player. The PC became the default original equipment manufacturer platform for a wide variety of instrumentation and control products. Microsoft's Windows software became the de facto standard on which hundreds of software and hardware systems built open systems—"open," providing they are Windows-based, Java-savvy, or Linux.

### ■ THE INTERNET

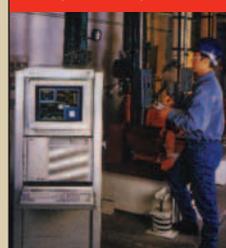
With the possible exception of computing itself, it is hard to imagine another technology (or, more properly, collection of technologies) that has more potential to alter process control technology than does the Internet. Not only are Internet technologies and tools being applied in myriad ways to facilitate automation, but they also are being used to interconnect automation professionals in ways unimagined fifteen years ago.

### ■ COMMUNICATIONS PROTOCOLS

ISA S50 standardized 4–20 mA analog signaling in 1982. Digital transmitters introduced in the mid-1980s by

Honeywell and Rosemount led to the open Highway Addressable Remote Transducer (HART) standard, which also worked on standard analog wiring. HART today continues to be a popular way to connect field instruments to control systems. Since the late 1980s, competing vendors have pushed nearly 30 different bus technologies as industrial field or device buses. The twelve-year "bus wars" ending in 1999 marked a decade of chaos for the ISA SP-50 standardization effort, which culminated in 1999 with the International Electrotechnical Commission (IEC) Committee of Action forcing a multiprotocol standard that wags still call the "eight-headed monster." Today, major protocols include Foundation fieldbus, HART, ControlNet, Profibus, DeviceNet, Modbus, Interbus, and AS-i. A recent survey, meanwhile, showed that more than one in five engineers use Ethernet or wireless Ethernet for either a majority or a portion of their measurements. Industrialized Ethernet flavors include Modbus/TCP, EtherNet/IP, ProfiNet, and Foundation fieldbus High-speed Ethernet.

**Desktop technology to plant floor**  
Wonderware, Intellution, Iconics, and others, 1990



### ■ GLOBAL AND ISA STANDARDS

Three years after its formation, ISA published its first standard on thermocouples (temperature measuring devices) in 1948. ANSI/ISA-50.1-1982 (4–20 mA analog signaling), officially known as Compatibility of Analog Signals for Electronic Industrial Process Instruments, is one of the most widely used standards in industrial automation. Among other notable standards efforts: SP5.1, Instrumentation Symbols and Identification, which enables anyone with limited measurement and control knowledge to read a flow diagram; S7, the original 3–15 pounds-per-square-inch air pressure standard; IEC 61158 international Fieldbus standards; ISA 50.01 Fieldbus; ISA-SP84, Programmable Electronic System for Use in Safety Applications; and SP88, Batch Control Systems, which also sired SP95, the Enterprise/Control Integration Committee. Each of these events was disruptive technology that changed the industry. What is the next disruptive technology? Wireless perhaps by 2006?

### ■ THE SMITH PREDICTOR

Developed by Otto J.M. Smith, a professor at the University of California-Berkeley, the Smith predictor essentially works to control the modified feedback variable (the predicted process variable with disturbances included) rather than the actual process variable. The Smith Predictor was a precursor to model-predictive controllers and PID-dead time controllers.

### ■ EMBEDDED ADVANCED CONTROL

Embedded multivariable predictive control (MPC), used to provide basic and advanced regulatory control, first saw light in 1999 with Foxboro's I/A Series process controllers. With Emerson's DeltaV control system in 2000, embedded MPC changed the tool kit available to the typical control engineer for the first time in forty years. MPC function blocks replaced many of the control techniques previously used to address multivariable process control problems.

**Combined DCS/PLC**  
Moore Products (Siemens), 1992

